

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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The Oil Situation

THE article on synthetic oil production contained on later pages of this issue of THE CHEMICAL AGE is a reminder of the vital importance of oil, both during the present war and, no less, during the years of peace. It has been said that in 1918 "the Allies floated to victory on a wave of oil." Since that time shipping has been converted to oil, armed forces throughout the world have been mechanised and now depend upon oil, and industry and transport, generally, have made impressive demands upon the world's oil supplies. It is evident that oil will play at least as great a part in this war as it did in the previous war, and in times of peace it is equally evident that if a nation successfully controlled the world's oil resources, it could equally control trade and dominate the world. At some time in the future years of peace—perhaps 25 years hence, perhaps 150 years hence, no man can tell—the world's oil supplies will be exhausted in some parts of the globe, and nations now secure in the possession of large oilfields will find themselves fighting for commercial existence. Research must therefore provide a commercial method of manufacturing oil from such elemental substances as carbon, water and air. That is the ultimate importance of such processes as those described by our contributor.

In the immediate present, of course, the oil situation dominates the war. The years which have intervened between the two German wars have seen intense international competition to control vital oil supplies. Germany has failed to do this but has probably been building up a petrol reserve ever since the signing of the Treaty of Versailles. The Nazis have encouraged the synthetic production of oil by every means in their power, and there are probably some 30 or more large synthetic oil plants at work in their country. In this country it has always been believed that these plants will be vulnerable to air attack, and so they appear to be; in consequence, Germany has been forced to beg for Russian oil and to take possession of the Rumanian oil fields. Italy has seized Albania which can yield half a million barrels of oil a year, and has been preparing for years to strike at Egypt (which produces 1½ million barrels a year) and to go on thence to the oilfields of Iran and Iraq; but Italy is still dependent on Germany, Russia and Rumania for her supply of oil. Production decreased in the Rumanian oilfields from 62 million barrels in 1934 to 48 million barrels in 1938, and there are grounds for supposing that the home needs of the Balkan States, coupled with very difficult transport over two single-track railways, will prevent Germany from getting more than 1½ mil-

lion tons of oil per year from Rumania. The importance of the Rumanian oilfields to Germany seems, however, to be that a very much more plentiful supply will be ensured should she attempt to march through the Balkans using Rumania as a base. Soviet Russia confiscated the British petrol holdings in the Caucasus at the time of the Revolution, since when the output of the wells has decreased; at the same time many activities of Russian life have been mechanised, with the result that Russia is endeavouring to import oil, and given an opportunity would undoubtedly cast covetous eyes upon the oil of Iran. It is unlikely that Germany will get any oil from Russia, unless the Democracies allow Russia to import oil ostensibly for her own needs.

The Axis powers are thus almost cut off from the world's oil supplies under present conditions. By contrast the Democracies have control of virtually the whole of these supplies. There may have been competition in the past between the oil companies of Great Britain and the U.S.A. for the control of the oilfields, but the united production of both nations is now merged for war purposes. The problem is to determine the extent of the German oil supplies and to reduce as far as possible the length of time which they will last. The German reserve of aviation petrol is said to be stored in underground reservoirs and to be conducted to the aerodromes by pipelines. Petrol is awkward to store and no doubt a good deal of crude petroleum would in fact be stored in the country. It is thus important to break up the oil storage tanks, where these can be reached, and to destroy the refineries and the synthetic plants producing oil from coal. It has been calculated that if the Germans made a big attack on this country every day of the year using 600 aeroplanes of various types, something less than 250,000 tons of petrol per year would be required. It is evident, therefore, that the reduction of the German petrol supply from this source is of small account. The collapse of the French resistance means that the German army is probably using oil at a very much slower rate than it would have done under the conditions of the last war. In addition, all private motoring has been stopped in Germany. The conclusion seems inescapable that, while oil is the Achilles heel of the Axis powers, only in the event of a long war or of very successful raids will Germany collapse from the lack of it. The unknown factor is the amount to which oil supplies have been accumulated in that country before the war. To a great extent this is a war between synthetic oil and natural oil.

CONTENTS

<i>The Oil Situation</i>	55
<i>Notes and Comments</i>	56
<i>Synthesis of Oils from Industrial Gases</i>	57
<i>Letter to the Editor</i>	60
<i>A Chemist's Bookshelf</i>	60
<i>Electrolytic White Lead</i>	61
<i>Sewage Purification</i>	62
<i>New Chemical Pack</i>	62
<i>Sulphuric Acid Concentration</i>	63
<i>Personal Notes</i>	64
<i>Chemical Matters in Parliament</i>	64
<i>New Control Orders</i>	64
<i>British Chemical Prices</i>	64
<i>General News from Week to Week</i>	65
<i>Commercial Intelligence—Stocks and Shares</i>	66

NOTES AND COMMENTS

Mercury Supplies in War

THE action of the Purchasing Division of the U.S. Treasury in buying up stocks of mercury from Mexico is an important step towards the consolidation of the position of the anti-axis powers in relation to this essential raw material. It provides a safeguard, among other things, against any political pressure from Germany or Italy that might be a factor operating against the fulfilment of the mercury-supply clauses of last year's Anglo-Spanish trade agreement. Furthermore, it puts an end to the Japanese purchasing monopoly of Mexican mercury stocks, which have amounted to some 200 to 300 tons per annum. Mercury prices, of course, on the London market are still high, and are likely to remain so in spite of a probable increase of imports from Spain, but there now seems to be no fear of any shortage of mercury from overseas. In this connection it may also be remembered that United States production of mercury is far from being negligible, and is, as we have more than once pointed out, on the increase. Germany, at the moment, is in a favourable position as regards mercury, for she is able to draw as much as she requires from the Italian deposits as well as an uncertain amount from Spain. In view of the present relations between the Reich and Italy it is worth noting that the chief quicksilver deposits in Italy were within Austrian territory until 1918. These are at Idria, not far from Gorizia, and produce about 350 tons per annum. There is another, although much smaller, purely Italian source in the cinnabar deposits on Monte Amiata in Tuscany. In quantity and quality of production, however, these are both far surpassed by the quicksilver at Almadén in Spain, the total annual capacity of which is about 650 tons, partly mined in a virgin state, partly in the form of cinnabar.

Export Obstacles and their Removal

DIFFICULTIES encountered by exporters in their efforts to develop the national export effort are revealed in a circular letter issued by the Institute of Export, the conclusions in which have been arrived at by the examination of letters sent to the Institute by many of its members. The position, it is stated, may be summed up in one phrase: "Inefficient organisation of export trade through its various channels." It is pointed out that no

less than seven organisations, five official and two unofficial are in existence, with the ostensible objective of "overcoming the difficulties now being experienced." The official bodies are the Board of Trade, the Department of Overseas Trade, the Export Council, the U.K. Commercial Corporation, Ltd., and the Export Credits Guarantee Department, while official problems appear to be caused principally by the control and licensing systems, difficulties of transport at home and overseas, and censorship delays. Among the outstanding cases of semi-official and private interference, the chief causes seem to be the heavy cost of insurance and the heavy cost of communications (e.g., cables being used to avoid mail delays). To clarify the position and ease the situation, the Export Council is issuing a questionnaire to members, and, it is hoped, by collating the confidential information that will thereby be collected, that the Council will be able "to take such steps as are open to them to have the matter raised in suitable quarters."

"Back to Tariffs"

SIR ERNEST BENN, the chief proprietor of THE CHEMICAL AGE, keeps the flag flying in a letter to *The Times*. The business world, he says, will be grateful to *The Times* for its pronouncement that the drying up of the channels of international trade in the last twenty years is a major cause of war. He doubts whether in volume and real value there was in 1938 half the world trade of 1913. Where he disagrees with *The Times* is in its criticism of the principles enunciated by Adam Smith, who, he says, surely knew nothing about the new-fangled science of planning and organising. Although remaining an unrepentant disciple of Adam Smith, Sir Ernest Benn would welcome a movement which said quite simply "Back to Tariffs." In theory at least, according to his argument, tariffs are not barriers to freedom, but are merely additions to price. Quotas and agreements, on the other hand, may have no bearing on price, but are straightforward denials of freedom. Within a tariff system the merchant can still exercise his individual judgment, search for new openings and perform his vital natural functions. But quotas and planning and organising "in the light of social and military needs," put the merchant out of business. Accordingly, he calls for a clearing of the channels of international trade from bureaucratic obstructions as the first step towards their re-opening.

Explosive Ink

STARTLING results followed the initial experiments of Mr. Carleton Ellis, an inventor of Montclair, N.J., in his efforts to prepare an ultra-rapid-drying printing ink. Mr. Ellis, who is an inventor of much experience (having recently taken out his 753rd patent) was induced to direct his ingenuity in the direction of quick-drying inks by a manufacturer of newspaper presses, who suggested that the speed of his machines could be much increased if an ink were available that would dry instantly. According to a paragraph in the *Manchester Guardian*, Mr. Ellis's first trial ink was so successful that it set with the suddenness of an explosion and ruined the apparatus that was being used. However, the principle was all right, and Mr. Ellis soon succeeded in slowing down the setting process. The ink, which has now been patented, is described as a dihydric alcohol polyester of an unsaturated dicarboxylic acid of the fumaric-maleic or citraconic-mesaconic-itaconic groups.

Synthesis of Oils from Industrial Gases

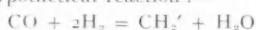
The Fischer-Tropsch and Allied Processes

by D. D. HOWAT, B.Sc., A.Inst.M.M., A.I.C., Ph.D.

A REPORT on the production of oil from coal by the Fischer-Tropsch and allied synthetic processes has just been submitted to the Minister for Mines. The report is based on a year's investigations by a special committee presided over by Sir W. Jowitt. Such processes, unlike hydrogenation, require some intermediate step, the coal being first broken down into the simple gaseous constituents, carbon monoxide and hydrogen, with varying amounts of other gases, the gaseous products forming the raw material for the synthesis. Only the Fischer-Tropsch process has been tried out on a commercial scale, although an allied process, the Robinson-Bindley, has been developed on a semi-technical scale by Synthetic Oils, Ltd., in this country.

Theory of the Fischer-Tropsch Process

In 1925 Professor F. Fischer and Dr. Hans Tropsch at the Kaiser-Wilhelm Institute discovered that paraffinic hydrocarbons resembling petroleum oils could be produced by catalysing the reaction between carbon monoxide and hydrogen at 200° C. and under atmospheric pressure. According to Fischer¹ the hypothetical reaction is:—



yields in the first place one CH_2' radical and one molecule in the presence of cobalt or nickel catalysts. The CH_2' radical is assumed to be the primary material giving rise to the formation of the aliphatic hydrocarbons.

Recent work by the Fuel Research Board² shows that large numbers of these methylene radicals may be formed on the surface of the catalyst, constituting the so-called "macro-molecules." From these, fragments are broken off to form the lighter products. In the Fischer synthesis the products actually obtained are hydrogenation cracking products of the macro-molecules of the methylene groups, caused by the presence of quite small amounts of absorbed hydrogen on the surface of the catalyst. Two factors appear to be at work and the products obtained may be unsaturated compounds (olefines), or lighter saturated hydrocarbons. Suitable control of the various operating factors should be capable of yielding products which are composed either substantially of olefines or of saturated hydrocarbons. Such a degree of control, however, does not seem as yet to be possible.

Development of the Process

The first pilot plant with a capacity of 1000 tons of primary product per annum was built in 1933 by Ruhrchemie A.G. A 30,000-ton-per-annum plant was built in 1936 at Oberhausen-Holten in the Ruhr by Ruhr-Benzin A.G., a subsidiary of the parent company. Ruhrchemie A.G. are now world licensees of the process, and it was announced in 1937 that twelve plants were either under construction or in operation in Germany under their licence. Plants are in operation also in France and in Japan, but up-to-date no large-scale installation has been built either in Britain or the U.S.A.

According to Fischer¹ the stages in the process are as follows:—

1. Production of the "synthesis gas," a mixture containing carbon monoxide and hydrogen in the ratio 1:2 parts by volume.
2. Preliminary purification of the synthesis gas from dust.
3. Removal of hydrogen sulphide from the synthesis gas by means of iron oxide boxes.
4. Final purification of the synthesis gas from organic sulphur compounds, the maximum sulphur content allowable being 0.2 gm. per 100 cu. m. or 0.087 gr. per 100 cu. ft.
5. Passage of the gas through the reaction chambers.
6. Condensation of water and oil produced.
7. Recovery of petrol and "gasol" from the residual gases by active carbon.

The production of the "synthesis gas" mixture is a relatively simple procedure, one of the useful advantages of the process being the variety of sources from which the mixture may be obtained. Probably the simplest method is to produce "blue water-gas" by one of the automatically operated processes, which have been brought to a high degree of perfection in this country. To attain the correct ratio of carbon monoxide and hydrogen generally calls for an extra step in the process. The water-gas may be treated with steam in the presence of iron, giving an increased yield of hydrogen, or coke-oven gas may be blown into the producer along with the steam, the methane present being reduced to hydrogen and carbon monoxide. Cheap and efficient removal of the organic sulphur is a more difficult procedure, but the work of the Fuel Research Board³ has proved that the so-called "luxmasse-sodium carbonate catalyst," maintained at a temperature of 200° to 300° C. is quite satisfactory for this purpose. A recent patent specification⁴ suggests the use of a mixture of ferric oxide and zinc oxide at a temperature of 500° to 550° C.

Among the more important problems encountered in the actual catalysis stage are the nature and composition of the catalyst and the design of the reaction chamber. Cobalt or nickel promoted or activated by various oxides such as

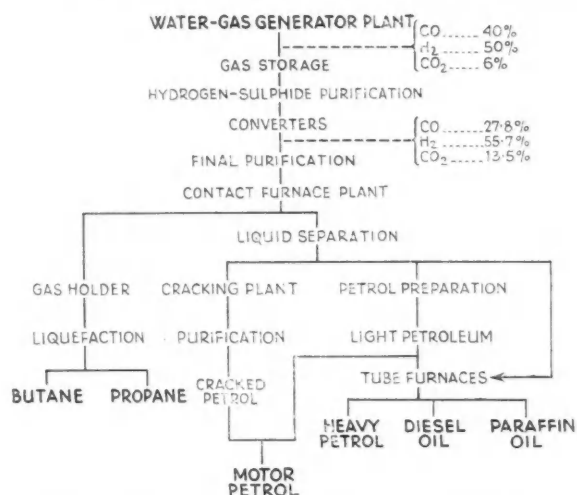


Fig. 1. Fischer-Tropsch Process for Industrial Synthesis of Petrol and Oil from Water-Gas (according to Dr. Martin).

thoria, alumina, manganese oxide, or magnesia, have proved to be the most efficient catalysts. One of the most recent patents granted to Ruhrchemie A.G.⁵ discusses the production of a cobalt catalyst with magnesia as a promoter, the ratio of cobalt to magnesia being about 100 to 10. In the experimental work carried out by the Fuel Research Board⁶ the mixture of cobalt and thoria is supported on acid-washed kieselguhr, the ratio by weight of the three constituents being 100:18:100. Two features of the catalysts call for comment. First, they are exceedingly sensitive to sulphur poisoning, the maximum permissible sulphur content in the synthesis gases being 0.087 gr. per 100 cu. ft. Second, their period of useful life is affected (a) by the amount of carbon absorbed and (b) by the gradual accumulation of a film of wax of high melting point on the surface. In a record of work by the Fuel Research Board⁷ the upper layers of the catalyst were found to be tremendously swollen in volume, the carbon content increasing from 2.4 to 88 per cent. A certain degree of revivification follows the periodical removal of the film of wax, and this may be effected in various ways. (1) The wax

may be removed by circulating certain gases through the reaction chamber. Nitrogen and hydrogen are both effective, the latter to a much greater degree. Nitrogen removes the wax film by purely mechanical means, while hydrogen acts both mechanically and chemically and is much more efficient. (11) The wax film may be dissolved by washing through the catalyst chamber some of the lighter oil fractions from the synthesis.

Design of Reaction Chambers

The necessary contact space in the reaction chambers must be very large with special provision for maintaining the temperature within the close limits of about $190^{\circ} \pm 10^{\circ} \text{C}$. The synthesis reactions are strongly exothermic and adequate facilities must be provided to carry off the surplus heat, temperatures above 200°C . tending to produce an unduly

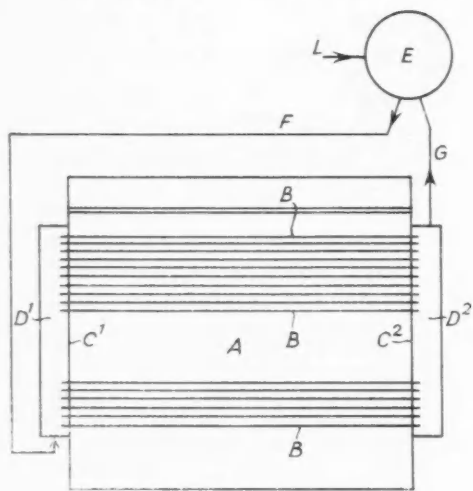


Fig. 2.

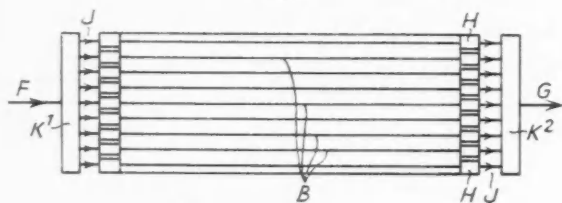


Fig. 3.

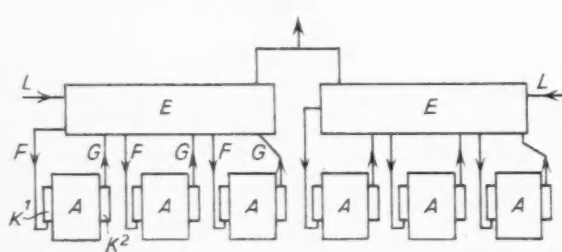


Fig. 4.

Catalytic apparatus, showing method of temperature control, in the synthesis of oils from carbon monoxide and hydrogen.

high proportion of methane. In the experimental work carried out by the Fuel Research Board⁸ the reaction vessel is like a horizontal water-tube boiler, the catalyst occupying the space surrounding the tubes. Superheated water is pumped through the tubes to maintain the required temperature in the catalyst space.

No account of the design of a commercial reaction chamber has been published, but two recent patents granted to Ruhrchemie A.G. throw some light on the type of plant employed. The reaction vessel is very similar to that just mentioned, but circulation is effected by thermo-siphon action

and not by pumping. As described in the earlier patent⁹ the apparatus, a sketch of which is shown in Fig. 2, operates as follows. From the boiler *E*, placed above the apparatus, the water enters the common chest *D*₁ from below, flows through the tubes *B* and enters the second common chest *D*₂ from which it returns to the boiler. The contact mass is maintained in the space surrounding the tubes *B*, the synthesis gas being circulated through this space. The water under pressure in the tubes absorbs the heat developed locally in the contact mass, then rises by thermo-siphon action to the boiler where it evaporates to an extent corresponding to the amount of heat absorbed and the constant steam pressure in *E*. Fresh water, to compensate for the amount converted into steam, is injected into the boiler at *L*. The pressure in the boiler is controlled automatically by a special device patented by Siemens Schuckertwerke A.G., the water being thus maintained at a constant temperature corresponding to that required in the reaction chamber.

An alternative system of main chests and headers is shown in Fig. 3, while the arrangement by which a number of reaction chambers are coupled to a common steam boiler is shown in Fig. 4. The last arrangement is very useful in equalising pressures and maintaining all the reaction chambers at the same temperature irrespective of the heat developed in any one. Since the water is under pressure, fairly thick-walled steel tubes are required in the reaction chamber, so that the cost of the unit is fairly high and a certain lag is possible in the temperature control. Improvements on this design are claimed in a later patent¹⁰ describing a high-pressure apparatus. In the modified apparatus the reactions are carried out at an elevated pressure corresponding approximately to the vapour pressure of the water flowing through the tubes. The pressure required is about 11 atmospheres. Synthetic gas at this pressure is passed through the reaction chamber, sheets of heat-conducting metal being disposed perpendicularly on the tubes at intervals of 10 mm. The temperature is controlled to a maximum of 187°C . With this arrangement the walls of the water tubes do not require to be resistant to high pressures and may be made thinner, thus reducing the cost and increasing the efficiency of heat-transfer.

The gases leaving the reaction chambers are cooled, the products being removed in three stages, (a) by direct condensation, (b) by oil washing, and (c) by scrubbing with active carbon. The products comprise a range of straight-chain paraffins and olefins from methane up to high-melting-point waxes. Appropriate fractions may be used as petrol and diesel oil. According to the patent mentioned¹⁰ the yield of primary products is from 120 to 130 gm. per cu. m. of synthesis gas at N.T.P. or about $7\frac{1}{2}$ to 8 lb. per 1000 cu. ft. The composition of the primary products is given as follows by Martin¹¹ :—

Fractions.	Olefine content per cent.	Per cent. by weight.
Gaseous hydrocarbons	50 to 55	8
Primary liquid product (B.P. up to 200°C .)	30 to 35	60
Gas oil	5 to 25	22
Solid paraffin (M.P. 20° to 100°C .)	—	10

From the primary products of the synthesis three different types of oils may be obtained: (a) petrol, (b) diesel oils, and (c) lubricating oils. The diesel oils, obtained by simple distillation, are exceedingly high-grade, having a cetene number over 100. They are thus very suitable for mixing with and improving poor-quality oils, such as tar oils, heavy petroleum oils, etc., providing a very useful diesel mixture.

The relative amounts of the different products depend on the fractions selected by distillation. The conversion of the lighter fractions into petrol may be effected by the same methods as are used for crude mineral oils. Owing to the paraffinic or straight-chain nature of the products, the octane number of the petrols produced is low, even doped fuel giving an octane number of only 65 to 70. This is, of course, quite valueless as an aviation spirit, fuels with octane number 100 being required for modern aero-engines.

The high olefine content of the primary material opens up the possibility of synthesising lubricating oils and practically all the work of the Fuel Research Board¹² has aimed at the production of satisfactory lubricating oils. Two methods have been used: (a) polymerising with aluminium chloride, and (b) chlorination followed by a condensation with aluminium amalgam. The product obtained by polymerisation gave test values which compared very favourably with the Air Ministry specification, except for the oxidation number which was over 3, as compared with the allowed maximum of 2. Polymerisation followed by hydrogenation resulted in a marked improvement in the viscosity index and in the oxidation number, which dropped to under 3, while the Ramsbottom coke values were substantially better than those obtained with commercial aviation oils. The yields obtained, however, were not of a high order. Good results were obtained by the second method of treatment. From the fraction of the original product boiling at over 200° C. at 18 mm. pressure, lubricating oil yields up to 32 per cent. of the initial materials were obtained in the experiments.

A recent patent¹³ granted to Rubrchemie A.G. deals with the production of lubricating oils from the primary synthesis products. The fraction boiling at over 150° C. is used as the starting product, being first cracked to mixtures of crude benzines at temperatures of 460° to 510° C. under pressures of 4 to 12 atmospheres. Tests have shown that the crude benzines so produced must possess certain characteristics before they will polymerise to form satisfactory lubricating oils. In the tests the crude benzines were split by distillation into fractions differing by 10° C. in the boiling point, the density of each fraction being then plotted against the boiling point. Only those mixtures which gave values falling within ± 1 per cent. of the "ideal density curve" shown in Fig. 5, were suitable for the production of oils. Crude benzines of this type gave, after polymerisation with aluminium chloride, 42 to 62 per cent. yields of oils having a viscosity pole height lying within the range 1.82 to 1.95, while benzines differing from the "ideal density curve" gave yields of only 3 to 28 per cent., the viscosity pole heights of the oils varying from 2.12 to 4.0. Test results are given substantiating the claims. The whole process is based upon purely empirical values, but it is obvious that the olefine content of the starting materials is not the only important factor in determining either the yield or quality of the oils produced by polymerisation.

The Robinson-Bindley Process

This process, developed by Synthetic Oils, Ltd., is similar to the Fischer-Tropsch process in many respects, but differs in a number of points. In an address delivered to the Institute of Fuel, Dr. W. W. Myddleton¹⁴ points out some of the important features of the process. (1) By limiting the hydrogenation of the primary products of the synthesis it is possible to produce, without the aid of additional plant for cracking, a satisfactory petrol and at the same time a high-grade diesel oil. An intermediate fraction is obtained suitable for the production of lubricating and transformer oils by polymerisation. (2) The composition of the synthesis gas need not be maintained at the ratio of carbon monoxide to hydrogen of 1:2, but may vary from 1:1 to 1:1.5. The gas mixture may therefore be obtained from the majority of solid fuels and the process of gasification simplified accordingly. Tully or Pintsch gas obtained from coal in one operation may also be used. (3) A sulphur-resistant oil-forming catalyst has also been found, so that extensive purification of the synthesis gas is no longer necessary.

The patent¹⁵ dealing with the process claims that "blue water-gas," with a carbon monoxide/hydrogen ratio of 1:1.17, has proved satisfactory. Two stages are employed. At a rate of flow of 100 volumes per unit volume of catalyst space, blue water-gas is passed over a catalyst containing cobalt or nickel with the oxides of manganese and aluminium, all supported on kieselguhr. The primary oils, produced at a rate of 147 c.c. per cu. m. of blue water-gas, are split into two fractions. The fraction boiling below 150° C. contains

up to 70 per cent. by volume of olefines and is used directly for the production of petrol, giving a material with octane number 63. The higher boiling fraction is vaporised, mixed with hydrogen, and passed, at a temperature of 120° C., over a hydrogenation catalyst containing nickel, manganese, aluminium, and silica. The catalyst is prepared by treating the metal oxides with a silicon ester, hydrolysing and reducing the product. The hydrogenated material is fractionally distilled to yield solvent oils, kerosenes and diesel oils, with cetene number 81.

The design of the catalyst chamber¹⁴ is similar to those already described. The gases enter each catalyst chamber at the top, passing downward through mild steel tubes, 19

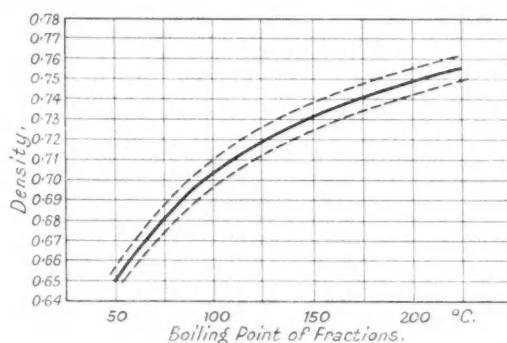


Fig. 5. "Ideal Density Curve," to which crude benzine mixtures must conform for polymerisation into satisfactory lubricating oils (B.P. 504,350).

mm. internal diameter, packed with catalyst. Water boils under pressure in a 10 in. steel tube surrounding the catalyst tubes. In a semi-technical plant, built in Scotland, the first battery of cells are treating 150,000 to 200,000 cu. ft. of blue water-gas per day, the yield claimed being 136 to 186 gallons of primary synthetic oil.

The Economics of the Processes

The production of one ton of oil by the Fischer-Tropsch process requires 5 tons of coke, if that is the raw material used, or the same amount of coal if gasified completely. Expressing it another way, a plant producing 30,000 tons of primary products annually will require 700,000 cu. m. of synthesis gas per day. Little definite evidence is available on the capital cost of a plant or on the actual operating costs, and in the report on Oil from Coal by the Sub-Committee of the Committee of Imperial Defence (Falmouth Committee) it was pointed out that widely varying estimates were given on both questions. For a 30,000-tons-per-year plant the capital cost may vary from £1,750,000 to £2,500,000, depending upon various factors. Again, the production cost appears doubtful, figures varying from 12½d. to 15d. per gallon being given for the same capacity of plant. One important variable in the production cost is, of course, the period allowed for amortisation.

From the economic and national defence aspects the Falmouth Committee did not recommend that Government assistance should be given for the construction and equipment of plants using any of the established processes for the production of oil from coal, adding, however, that "it would be of considerable advantage if the establishment of a plant to work the Fischer process and designed to produce 20,000 to 30,000 tons of primary products per annum could be secured." It is exceedingly difficult to imagine how the necessary capital for a plant of such capacity could be raised from private sources.

There are other aspects of the decision of the Falmouth Committee to which attention has been drawn by Dr. A. J. V. Underwood.¹⁶ In accordance with his remarks, the following criticisms may be made. First, undue emphasis has been placed on the discrepancy between the cost of imported oil and that of the synthetic product. Development in the synthetic processes has been very rapid and there is no reason

to believe that, granted normal conditions, the difference in cost might not be quite rapidly reduced. Second, the world's existing coal reserves are probably much more extensive than the oil reserves and it would appear only reasonable to prepare against the time, far in the future though it may be, when it will become imperative to produce from coal at least a considerable fraction of the world's demands for oil. Third, the transport by sea of the quantities of oil required by a nation at war throws a serious strain on the available tanker tonnage and on the naval forces necessary for escort work. Fourth, the establishment of an industry based on the conversion of coal into oil would be of tremendous importance in the development of chemical engineering technique and towards the training of chemical engineers. It would create associated and auxiliary industries which could be of great value in reorienting the industrial basis of the country, affording a valuable counterweight to the (perhaps undesirable) predominance of the "heavy industries." Fifth, it would appear, in spite of allegations to the contrary, that the establishment of such industries would go far to balance the loss of revenue to the Exchequer through preference on home-produced oils. Under present conditions it is not likely that the Government will alter the policy already formulated, but it is to be hoped that a real stirring of technical and public opinion on the question of producing oil from coal will be one result of the submission of the report of Sir W. Jowitt's committee.

From hydrogenation plants the high-octane-number fuel, suitable for modern aero-engines, could be produced. But the establishment of one or more synthetic plants utilising

industrial gases for the production of oil would have the following advantages: (a) operated in conjunction with coke-oven plants, they would utilise in a highly efficient manner gaseous by-products that now are frequently put to relatively uneconomic uses; (b) useful supplies of diesel oils and lubricating oils, essential both in war and peace, would be made available; and (c) petrol would be produced, useful for blending with higher quality fuels for use in ordinary road transport.

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- (12) Fuel Research Board: Annual Report to March 31, 1939, pp. 167-176.
- (13) B.P. 504,350: Process for the synthetic production of lubricating oils.
- (14) W. W. Myddleton: *Colliery Guardian*, 1938, **157**, p. 286.
- (15) B.P. 491,778: Improved process for the synthesis of hydrocarbons from carbon monoxide and hydrogen.
- (16) A. J. V. Underwood: *Fuel Economy Review*, 1938, **17**, p. 14.

LETTER TO THE EDITOR

Bleaching Earth

SIR.—May I furnish you with a few more facts in completion of the article, "Bleaching Earth," by Dr. Frederic Neurath?

In Central Europe, during the last years preceding the outbreak of war, besides the mentioned Skoda-Wetzler Works at Moosbierbaum (Austria) and the Phoenix Works at Bajamare (Rumania), two plants for the manufacturing of bleaching earth on a large scale were set up by Dynamite Nobel, Ltd., at Bratislava (Czechoslovakia) and at Nagytetyeny (Hungary).

The process of activation developed during my collaboration with the last-mentioned company was on somewhat different lines from that described in your article and is covered by the patent specification Ger. P. 682641 (Oest. Dynamite Nobel A.G., Wien.).—Yours faithfully,

c/o Nitrogen Fertilisers, Ltd.,
Flixborough, Scunthorpe, Lincs.
January 18, 1941.

J. M. FANTO.

A CHEMIST'S BOOKSHELF

WORKS BOILER PLANT. By F. J. Matthews. London: Hutchinson. Pp. 184. 10s. 6d.

This book, by the author of "Boiler Feed Water Treatment," can be thoroughly recommended to chemical engineers who have boilers on their works. It is a compressed account of nearly every factor of importance in the management of boiler plants. One is, indeed, in some doubt whether to call it a short text-book or a long handbook, but whichever it is it reflects considerable credit upon the author. After less than two pages dealing with the elementary facts of heat and steam generation, a chapter follows on combustion in the boiler furnace, draught and chimney calculations, and prevention of air infiltration, ending with a discussion of the operation of an Orsat gas-analysis apparatus. The third chapter deals with the selection of coals, the formation of clinker and coal storage. It is of interest to observe that the author seems to approve of the principle of wetting the coal before burning

and his reasons for that view are decidedly interesting. A short chapter on mechanical stoking is not encumbered by descriptions of commercial stoking appliances. Superheating, corrosion, economisers, the preheating of feed water and air, and condensers are next dealt with; and a later section indicates the methods of economising heat in boiler practice, including thermal storage in accumulation. Boiler feed water treatment and boiler fittings and auxiliaries are adequately covered, and the book ends with chapters on operation and maintenance and boiler tests. It will be seen that this is an eminently practical book. Theoretical discussions are avoided, as are descriptions of appliances except in so far as simple arrangement diagrams are needed to illustrate principles. A useful and unusual feature of the book is that the text is given on the left-hand side of the page, while the right-hand side is reserved for the most part for illustrative notes, calculations, and diagrams. This is, we repeat, a book that can be thoroughly recommended.

PHOTO-SYNTHESIS. By E. C. C. Baly, C.B.E., F.R.S. London: Methuen. Pp. 248. 15s.

This is the third book that has appeared under the title of "Photosynthesis," the two previous ones having been written by Professor Stiles and Dr. Spoehr. The synthesis in living plants of carbohydrates from carbon dioxide and water by the agency of sunlight is discussed as a problem in physical chemistry. Its importance lies in the fact that it is the fundamental process of life and that in the leaves of plants the whole supply of the carbohydrates and proteins that are needed by animal and man is produced. The introductory chapter deals with photosynthesis and the difficulties of its interpretation, while the following sections lead from the early investigations on the subject to the final achievement of the photosynthesis of carbohydrates. The assimilation of nitrogen by the living plant, whereby protein and other complex nitrogen compounds are produced, ranks in importance with the photosynthesis and is the subject of another section. The book ends with the mechanism and the kinetics of photosynthesis and, completed with 24 diagrams and 28 tables, deals most comprehensively with a theme which during recent years has developed a new significance.

Electrolytic White Lead

Operational Details of the Process

PROBABLY no pigment is prepared on such an extensive tonnage basis by electrolytic means as white lead, which despite practical complications of the reactions is today successfully carried out on a very considerable scale.

As white lead is a basic carbonate of lead, the business side of the production has been linked up with scientific activities in a manner rarely seen in most industrial pursuits. To make this clear, since all by-products are utilised more or less completely in a continuous circuit, the only raw material required is metallic lead and hence the process is unique in this respect. Recognising this fundamental feature, one of the largest producers, the Anaconda Co. of America, connected a lead refinery with the white lead plant in much the same manner as was done earlier with firms engaged on the Dutch white lead process. Whereas the latter system involves the use of vast quantities of acetic acid, the electrolytic process regenerates the acetate required, and accordingly the costs of working include labour, electric current, metallic lead, and plant depreciation. The electrolytic system applies a final refining treatment to the lead so that whereas pure lead is necessary with the Dutch process, this is not so imperative with the former.

In keeping with the continuous nature of the electrolysis, the initial refining of the lead by pyro-metallurgical method is also carried out similarly, in the most expeditious manner. Instead of melting the different residues and raw lead products in stationary hearths, rotary furnaces are used which are equipped with mechanical conveying devices, so that the human hand scarcely requires to be applied. The molten product is tapped off at intervals to large refining kettles fired by oil-fuel, and antimony and other impurities are taken off by drossing. Where a sufficiency of copper is present to justify the treatment, the molten mass is cooled to a dull red heat to allow an alloy of copper and antimony to form on the surface and be skimmed off separately, but failing this, the earlier system of sulphurising the copper is applied. One of the latest additions is the use of a calcium-magnesium alloy which is added to the molten lead to cause bismuth to float on the surface and be easily skimmed off. The refined lead is cast into anode plates on a circular casting device equipped with a compressed-air ram situated beneath, and immediately the lead has solidified, the ram automatically thrusts up the anode plate, which is then transferred on trucks to the electrolysis baths. Throughout the initial melting and refining system, continuous working is an accepted maxim, and the final anode plate, complete with holes at the top for fitting to the anode bars connected to the bus-bars in the bath, is obtained without interruption. In view of the type of electrolyte used in the bath, it is unnecessary to pursue the refining too far, as the electrolytic process itself acts as a refining system, and except for the setting up of additional resistances, impurities could more or less be ignored. With the Dutch, or other alternative methods of preparing white lead, pure metal is essential. The following is an analysis of lead prior to the final skimming which is necessary:—

98.86 per cent. lead, 0.38 per cent. copper, 0.67 per cent. antimony, 0.007 per cent. arsenic, 0.008 per cent. bismuth, 0.02 per cent. iron, 0.025 per cent. zinc, and 0.006 per cent. nickel.

In order to make absolutely certain that impurities such as copper and iron would not tint the white lead, this metal was subjected to further skimming and then cast into "buckles" preparatory to corrosion, which analysed as follows:—

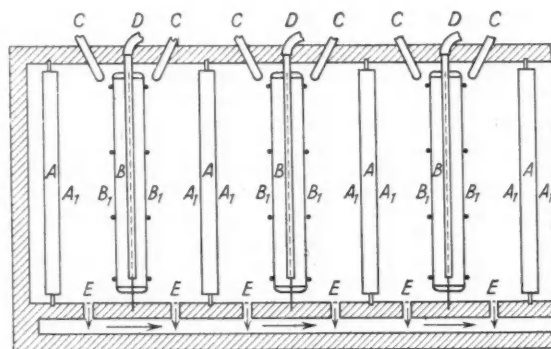
99.66 per cent. lead, 0.009 per cent. copper, 0.20 per cent. antimony, 0.003 per cent. arsenic, 0.002 per cent. bismuth, 0.001 per cent. iron, 0.017 per cent. zinc, and 0.003 per cent. nickel.

No such refining is necessary for the electrolytic anode

plates wherein impurities are collected as anode sludge, and except that undue resistances would be set up to the passage of the current, almost any class of lead can be utilised.

The lead anodes are electrolysed in asphalt-lined tanks, the lengths of which are made to suit the type of building used, and are usually 3 ft. in height and 4 ft. wide. The dimensions of these anode plates are $2\frac{1}{2}$ ft. by $3\frac{1}{2}$ ft., and $\frac{1}{4}$ in. thick, and they alternate with each cathode, which is represented by a steel sheet.

This cathode is housed within a linen sack which acts as the diaphragm (ordinary Irish linen suffices for this work, although earlier much research was devoted to acquiring specially selected fabrics, asbestos, etc., which added to the practical difficulties).



Plan of electrolytic bath section

A. Lead Anode. A₁. Anolyte. B. Cathode. B₁. Catholyte. C. Feed to anolyte, principally sodium acetate. D. Feed to catholyte, principally sodium carbonate, distributed over top of cathode. E. Outflow of white lead, suspended in sodium hydrate solution, passed to settling tanks, and filter. Sodium hydrate passes to carbonating towers for regeneration as sodium carbonate. The diaphragms of linen fitted around the cathodes are held in position by four rubber rods on either side.

During the electrolysis, instead of the solution being regarded as one electrolyte, as is common in other general processes, the distinctive reactions of both anolyte and catholyte are most important. The solution which surrounds the lead anode, or anolyte, consists of sodium acetate with a very small amount of sodium carbonate, whilst that which surrounds the iron cathode, or catholyte, consists of sodium acetate with a large proportion of sodium carbonate. Both electrolytes are maintained in rapid circulation around each respective electrode by independent circulation systems, and no connection can be made between the one and the other except through the porous diaphragm.

A combination of electrolysis and chemical precipitation proceeds as the current passes through the electrodes, and it is the current which controls the precipitation and disposition of the reagents. The white lead which is precipitated by the reaction of the sodium carbonate solution predominating in the catholyte would tend to set up undue resistances to the passage of the current if it were not removed, but by the circulation system no such difficulties are encountered. The current causes the lead to be dissolved as acetate, thus continuously corroding the surface of the metal, and the process then reverts to that of a simple chemical reaction with sodium carbonate.

Although the cathode is housed within a porous diaphragm, the catholyte circulates outside the cell, and becomes replenished with those ions of which it was depleted by migration through the fabric.

(Those desirous of working this process experimentally are recommended to be content to work with very dilute sodium acetate until the conditions of applying the current and regulating the circulation have been perfected, rather than risk using more strongly corrosive solutions.)

The bus-bars used are of aluminium, as with the usual

copper bus-bar some coloured matter might enter the fine precipitate, and to avoid any danger of leakage of the positive and negative circuits, which is important where accurate current control is concerned, the supports are of vitreous enamel, or glazed ware, rather than of wood. The consumption of current is not considerable, and works out at 0.12 to 0.15 kWh per pound of white lead produced. As the lead is dissolved off the plate, the latter becomes thinner, providing a greater space between anode and cathode, and this tends to increase the temperature, which should range from 24° to 32° C. Despite this, the electrolysis is continued until the skin of metal is so thin that holes almost appear.

In order to maintain consistent conditions, when starting with fresh cells, the dilute sodium acetate is given 0.05 per cent. sodium carbonate before switching on the current, so that the electrolyte in the anode compartment, or anolyte, will not have an opportunity of altering. By making a close scrutiny of the process in operation it will be noted that the catholyte, or sodium carbonate solution, passes by an apparently downward action through the porous diaphragm, and rises to the top clear but frothy. The point where the lead-carrying sodium acetate solution meets with the sodium carbonate catholyte cannot be accurately discerned, and all that is noted is that it has become densely white. The latter liquid is drawn off from the bottom of the tank, and upwards to the outflow, which latter is connected from one tank to another, when it passes on to settling tanks.

The process is most easily understood when seen in operation, since when the lead is dissolved by the action of current and sodium acetate, the solution so formed is precipitated only a very slight distance from the surface of the anode. By the descending action of the anolyte this surface remains clean, and thus corrosion proceeds unhampered, since no white deposit is allowed to remain upon it. The sodium carbonate becomes hydrolysed with evolution of hydrogen, and hence no actual sodium carbonate is permitted to come in contact with the surface of the lead anode. Where traces of the carbonate appear in the anolyte, no dissolved lead salts are present. The ions of the catholyte from the iron cathode, i.e., carbonate and hydroxide ions, migrate through the surrounding linen sack, or diaphragm, towards the anode. By so doing, the anions removed from the anolyte are replenished, i.e., those which have been produced by the precipitation of the lead ions. What anions are necessary to meet the requirements of the cations are met by this electrolytic migration in electro-chemical equivalents. As despite the accurate control used, which is almost entirely done by means of automatic regulating and recording instruments, a certain seepage persists through the porous diaphragm, it is necessary to compensate for the small amount of catholyte that passes into the anolyte. This is done by deliberately adding a small proportion of anolyte to the catholyte, and is necessary whatever type of fabric is used as the diaphragm. Samples of both anolyte and catholyte are periodically tested chemically to note when such additions are necessary. This slight addition allows the current to react with acetate which would not otherwise be present in the catholyte, and the acetate ions replace a portion of what carbonate and hydroxide ions migrate to the anolyte. Except for a very slight concentration of acetate, the anolyte remains unchanged in its passage through the cell, and this is rectified by addition of a little wash water from the filters. On the other hand, the catholyte, having been enriched in hydroxide ions and the carbonate having been removed by the precipitation of white lead, is represented by a solution of crude sodium hydrate. Although the characteristic odour of acetic acid persists within the electrolysis rooms, comparatively little loss is sustained, and any little replenishment is made by the addition of anolyte to catholyte mentioned.

The continuous circulation of the anolyte carries the precipitated white lead to settling tanks and filters, where it

is washed and passed along a lengthy drier to a battery of disintegrators, after which it is air-floated and finally packed in barrels. As there are demands for different types of white lead, this is easily met by altering the conditions within the electrolysis bath.

The only regeneration required is that of carbonating the catholyte which has been hydrolysed, and this is simply done by running it down coke-filled towers through which carbon dioxide gases from a coke-fired boiler ascend to meet it. This carbonated solution is then pumped to storage tanks situated above the electrolysis baths, and run off as required. Air-conditioning is an important matter in pure white lead production, and all sections of the foregoing plant have equipment for this purpose.

On analysis, the product is generally completely free from any trace of acetic acid, has a moisture content of from 0.25 to 0.35 per cent. insoluble matter rarely exceeding 0.020 per cent., and has no suggestion of foreign metals present.

Regarding physical properties, the following figures are given for Anaconda white lead:—

Particle size. Weighted average	0.95 to 1.84 μ
Hiding power (Pfund Cryptometer) per lb.	13.00 to 28.30 sq. in.
Tinting strength (ultramarine Du Pont numerical strength scale)	75 to 130 per cent.
Specific gravity	6.81
Residue on 325 mesh	0.108 per cent.
Oil absorption (Gardner-Coleman) per 100 gm.	11.75 to 19.50 cc.
Oil absorption (Standard Rubout method) per 100 gm.	8.35 to 14.88 cc.

Sewage Purification

Improvements in Activated-Sludge Process

IN a paper on "The Design of Sewage Purification Works," discussed at the Institution of Civil Engineers, Westminster, last Tuesday, Mr. Herbert Cecil Whitehead, M.Inst.C.E., stated that the method of sewage purification should be an orderly sequence of balanced operations or stages designed to separate from the water the different kinds of impurities contained therein, so that the appliances used are appropriate to the work required of them. The significance of the chemical analysis of sewage was explained in detail.

Sewage purification requirements for inland towns were outlined, and a recommendation was made that partial treatment for stormwater should be extended. The stages of treatment in common use were enumerated, and the bases of design examined and criticised. In particular, the various factors affecting the oxidising capacity of percolating filters were examined. The author defined these factors as liquor facility, distribution, medium, temperature, and ventilation for aeration. He likened the percolating filter to an industrial community of selected workers so arranged as to encourage the greatest output of useful work, and described recent variations in methods of operation of percolating filters with the object of attaining greater efficiency.

He discussed the activated-sludge process in its application as a single process and for biological flocculation, and presented suggestions for counteracting in design and operation the disability under which the process operates owing to the low rate at which a mass of sewage can take up atmospheric oxygen. The design of tanks for the separation of humus and activated sludge was referred to, and a brief review of sludge treatment and disposal was made.

NEW CHEMICAL PACK

Recent research in the United States has revealed that the oxidation of such products as olive oil can be retarded considerably by a special packing with coloured cellophane. The chief factors in influencing such protection are the quantity of light, particularly ultra-violet light, transmitted by the cellophane, and the stability of the dye in the cellophane to the reaction of light. Experiments have shown that deep red, orange, violet, grass-green, and lemon-yellow give the best protection.

Sulphuric Acid Concentration

Chemical Engineers Discuss Plant Design

AS might have been expected, the paper presented by Mr. P. Parrish last week, at a joint meeting of the Institution of Chemical Engineers and the Chemical Engineering Group of the S.C.I.—the subject being "Modern Developments in the Design of Plant for the Concentration of Sulphuric Acid"—evoked a lively and interesting discussion. Some reference was made in our columns last week to the paper itself; the nature of the discussion testifies to the importance of Mr. Parrish's observations.

DR. M. W. TRAVERS noted that it was very difficult to make a truly scientific analysis of the performance of a very simple evaporator such as the pot-still. Although it was common to try to control the operation of evaporators of the ordinary type by placing a thermometer in the combustion chamber outlet, the best way was by means of the eye, and that, of course, called for an experienced operator. Dr. Travers emphasised the importance of keeping accurate detailed records of all plants and of analysing the records from time to time.

MR. S. J. TUNGAY expressed surprise that the pot type of concentrator was advocated so much nowadays, since very good results had been obtained with some of the modifications of other types. The Kessler type of plant had done extraordinarily good work, and its fuel consumption was very good, while the Gaillard type of plant was rather costly in fuel. There were certain difficulties in the construction, and in view of that he was not at all surprised that the Gaillard tower system had been superseded. The cascade type was another which was still giving good service, producing water-white acid in cases where colour was important. Plant of this type was yielding 95-96 per cent. acid for 13 per cent. fuel consumption.

With regard to the acid losses involved in the various systems of concentration, he assumed that the pot system had the advantage because there was likely to be less acid carried over in that system than in the Kessler system. But he saw no real difficulty in regard to the connecting pipes from the still, provided a satisfactory system of expansion joints were adopted; that should be easy, even when using a high-silicon iron. Most of the reputable manufacturers of high-silicon irons were using a certain amount of steel as a source of raw material, and they were applying a normalising process.

MR. A. B. SCORER, who also referred to high-silicon iron, said that during the last war his firm had been concerned very largely with the cascade type of concentration plant, but nowadays they were concerned almost entirely with the pot plants, and the dephlegmators had stood up to their work very well indeed. It was possible for the designers of dephlegmators and similar plant, in collaboration with the manufacturers, to arrive at a much better design.

The Drum Concentrator

MR. F. E. WARNER said it was well to bear in mind, in considering acid for explosives production, that 93 per cent. was sufficient for the concentration of weak nitric acid to concentrated nitric acid. Alluding to the merits of the drum concentrator, Mr. Warner said that whereas the pot-still type, in order to achieve optimum concentration, required to be fed with acid at about 95 per cent., the drum concentrator would concentrate acid of 65 per cent. directly to 93 per cent. It consisted essentially of a furnace and a vessel divided into two compartments. The fuel used in the furnace was oil or producer gas, mixed with secondary air in order to lower the temperature, and the mixture was blown into the two-compartment vessel. Acid was fed into the weak-acid end of the vessel, it overflowed continuously into the strong-acid end, and then overflowed into the acid cooler, which was of normal design. The air used for burning the producer gas and for diluting it to reduce the

temperature was provided from a high-speed centrifugal blower, so that the whole plant was under positive pressure and there was no worry about back pressure. The gases leaving the drum were passed to a further stage of cooling, followed by scrubbing, and then were usually passed through an electrostatic precipitator.

The drum worked well when concentrating in one stage from 67 to 93 per cent. The only trouble was that, being an easy-going animal, it could quite easily be overworked. After all, a drum handling each week about 120 tons of acid at about 70 per cent, and producing about 85 tons of 93 per cent. acid per week was comparatively small, the dimensions of the outside shell being about 30 ft. by 9 ft., and there was a lining inside that. There were no moving parts in the acid, and the plant gave little cause for worry.

MR. A. J. PRINCE referred to other methods of concentrating acid not mentioned in the paper. He said there were also the Mantius method of vacuum evaporation, which used steam instead of the combustion of coal or coke, and the falling film method of concentrating, which had been used in the United States with some success.

MR. R. S. COLBORNE said it seemed to him that nearly all the trouble in sulphuric acid concentration was due to working at high temperature. Therefore, he was rather surprised that he had not heard more about concentration in vacuum in order to reduce the temperature as much as possible. Again, nobody ever seemed to think it worth while to concentrate acid below 67 per cent, but at the present price of sulphuric acid it seemed that it would pay to concentrate at a much lower percentage than that, and he asked whether any work was being done in that direction.

MR. R. JOHN LOW, MR. E. D. COPLEY, and MR. W. HALL SIMMONS also spoke in the discussion.

Mr. Parrish's Summary

MR. PARRISH, in a brief reply, said he had no intention of making any attack on manufacturers of silicon iron. Indeed, he had in his possession some silicon iron, made 27 years ago, which was as good as when supplied. On the other hand, there had been failures, and one was asked to explain them from time to time. Apparently the manufacturers were proceeding, on well-defined scientific lines, to improve the quality of the material. With regard to the drum concentrator, he agreed that it was reliable and scientific for producing acid up to concentrations of 90 and 92 per cent.; but if one tried to drive that willing animal too far and to produce 96 per cent. acid, one produced clouds of dissociated sulphuric acid with which the electrostatic precipitator was expected to deal. That was obvious from the examination of the partial pressures of sulphuric acid. One could concentrate up to 90 per cent. quite satisfactorily by means of heated gases, but for concentrating up to 96 or 97 per cent. the acid, with its sensible heat, must be brought into a closed pot and heat must be applied to the outside of the pot.

The paper was essentially devoted to the concentration of denitrated waste acids, a problem with which the country had to deal at the moment. He agreed with Mr. Tungay that the Kessler system was all right scientifically for concentrations up to 92 per cent. Again, he agreed that the cascade concentrators were used a good deal during the last war, but he did not think anyone would be inclined to instal cascade concentrators to-day for large quantities of sulphuric acid. For the production of pure sulphuric acid with water-white characteristics one might adopt the cascade system to-day, however.

In reply to Mr. Colborne, Mr. Parrish said there were evaporators in use to-day which would deal with waste acids for the parchmentising of paper, acids which were of 40-45 per cent, and were concentrated to about 78 per cent.

Personal Notes

DR. FRANK C. HALL, A.I.C., of Foster Wheeler, Ltd., has been elected an Associate-member of the Institution of Chemical Engineers.

RAJ MITRA B. D. AMIN, of the Alembic Chemical Works Co., Ltd., has been elected president of the Indian Chemical Manufacturers' Association for the current year.

MR. FRANCIS C. FRARY, director of research of the Aluminum Co. of America, has been elected president of the American Institute of Chemical Engineers for 1941.

MR. T. F. A. BOARD has been appointed by the Minister of Supply as Controller of Molasses and Industrial Alcohol and MR. L. P. B. MERRIAM as Controller of Plastics.

MR. JAMES SOMMERVILLE ANDERSON, lecturer in secondary metallurgy at Melbourne Technical College for two years, has been appointed lecturer and investigator in secondary metallurgy to the Adelaide School of Mines from February 1.

The wedding took place on January 18, at Holy Trinity, Brompton, SECOND-LIEUT. JOHN LESLIE LUTYENS, R.E., son of Mr. W. F. Lutyens, director of I.C.I., Ltd., and MISS RUTH HOTOPI, daughter of the late Mr. Norman Hotopi, director, until his death in 1938, of J. M. Steel & Co., Ltd.

The Minister of Supply has appointed MR. F. W. BAIN, M.C., to be Chairman of the Chemical Control Board, which will deal with questions relating to the control and development of supplies of the chemicals falling within the scope of the Raw Materials Department of the Ministry of Supply.

DR. WILLIAM LLOYD EVANS has been elected President of the American Chemical Society for 1941. DR. HARRY N. HOLMES was chosen President-Elect. Dr. Evans is noted specially for his work on the carbohydrates and is chairman of the chemistry department at Ohio State University. Dr. Holmes is professor of chemistry at Oberlin College.

MR. LEONARD BROWN, general manager of the rubber goods division of the Dunlop Rubber Co., Ltd., has retired for reasons of health. He had been in the rubber industry since 1899 when he joined Charles Macintosh & Co., Ltd. (now incorporated in Dunlops) as a junior clerk at the age of 16. Mr. Brown is a member of the Institution of the Rubber Industry and has had a long and active connection with the India Rubber Manufacturers' Association.

OBITUARY

MR. ROBERT MACDONALD, Scottish representative of Messrs. James Ferrier & Son, explosive merchants, 342 Argyle Street, Glasgow, died recently at the age of 65.

MR. JAMES FINDLAY, of Messrs. M. Findlay and Co., manufacturers of explosives, Glasgow, has died in his 86th year. He joined his brother in the firm about 30 years ago.

MR. JOHN H. G. FORBES, formerly for over 20 years a partner in Forbes and Drew, chemical works, Brightmet, Bolton, and for the past 18 years a chemical manufacturer in Accrington, died recently aged 70.

DR. FREDERICK W. SKIRROW, formerly Professor of Chemistry at McGill University, Canada, died recently at Victoria Hospital, Morecambe, aged 64. He went to Canada in 1910 and was Professor at McGill University for five years. He then took up an appointment as consulting chemist to Shawinigan Chemicals, Ltd., and returned to England ten years ago as Technical Director of the same company.

MR. MEURIG LLOYD DAVIES, F.C.I.C., of the Standard Chemical Co., Ltd., of Toronto, died at his Toronto residence on December 17, aged 75. Mr. Davies was born in Liverpool and educated at Liverpool College and University. He entered the chemical industry as a works chemist with James Muspratt & Sons, becoming manager of the Liverpool works in 1890. In 1899 he went to the United States, and in 1913 he came to Toronto as general manager of the Standard Chemical Co., becoming president in 1924. He retired from the presidency in 1939, but was a director at the time of his death. Mr. Davies was president of the Canadian Chemical Association in 1932-33, and of the Canadian Institute of Chemistry in 1935-36.

New Control Orders

Caustic Potash and Carbonate of Potash

THE Minister of Supply has made the Control of Caustic Potash and Carbonate of Potash (No. 2) Order, 1941, which revokes the (No. 1) Order previously in force. Under the new order, which came into operation on January 18, the purchases for consumption of caustic potash and carbonate of potash which may be made by any one person without licence are now restricted to lots not exceeding in the aggregate 5 cwt. a month, except in the case of liquid caustic potash where the corresponding amount is 13 cwt. a month of material not exceeding 55 per cent. KOH. It is probable that in future caustic potash will only normally be available in the liquid form.

Chemical Matters in Parliament

Roche Products, Ltd.

IN the House of Commons on Tuesday, Major Lloyd George, Parliamentary Secretary, Board of Trade, in a written reply to Sir Ernest Graham-Little, said he was informed that the relationship of Roche Products, Ltd., of Welwyn Garden City, with the firm of F. Hoffmann-La Roche and Co., of Basle, was based on agreements covering interchange of commercial, technical, and scientific information, particularly research and patents. Mr. Dalton, Minister of Economic Warfare, informed Sir Ernest Graham-Little that the question of the possibility of there being any direct or indirect financial relationship between the Hoffmann-La Roche Company, of Basle, parent company of Roche Products, Ltd., and the German concerns of Bayer Products or I.G., had been carefully investigated, but he had found no evidence that any of the payments made to Roche Products, Ltd., would pass to Germany through Switzerland.

British Chemical Prices

Market Reports

A GENERALLY good demand is reported for industrial chemicals and the tone of the market is strong. Quoted prices show no material change on the week, although contract bookings over the next few months are expected to be based on revised rates. The movement in the aggregate is fairly substantial and at the consuming end deliveries are reported to be satisfactory. Business in coal tar products has been on a good scale and values for most items are well held. Dealers are awaiting particulars of the extension of official control which are expected to be published shortly.

MANCHESTER.—Both home and export inquiry on the Manchester chemical market during the past week has been on a fair scale and some substantial additions to actual order-books have been reported in the leading heavy products. Delivery specifications for textile and other consumers this week have, on the whole, been satisfactory. Values in most sections of the market are extremely firm in undertone and future movements are likely to be upward. In the by-products section a feature since our last report has been a fresh rise in solvent naphtha and xylol, with a stiffening also in creosote and anthracene oils, with a good demand reported.

GLASGOW.—Business in the Scottish heavy chemical trade both for home and export still remains quiet. Prompt delivery for goods not in stock is still very slow. Prices keep firm.

Price Changes

Antimony Sulphide.—Golden, 1s. 9d. to 2s. per lb.; crimson, 10d. to 1s. 6d. per lb.

Cadmium Sulphide.—5s. 6d. to 6s. 6d. per lb.

Carbolic Acid.—Crystals, 9½d. to 10½d. per lb.; crude, 60's 3s. 6d. to 4s. 2d., according to specification. MANCHESTER: Crystals, 10½d. per lb. d/d; crude, 3s. 6d. to 3s. 9d. naked at works.

Carbon Black.—5½d. to 7½d. per lb., according to packing.

Creosote.—MANCHESTER: 5d. to 7½d. per gal.

India-Rubber Substitutes.—White, 5½d. to 7½d. per lb.; dark, 5½d. to 6d. per lb.

Naphtha.—MANCHESTER: 90/160, 2s. 3d. to 2s. 5d.

Pyridine.—MANCHESTER: 13s. 6d. to 17s. per gal.

Sodium Metasilicate.—£14 15s. per ton, d/d U.K. in cwt. bags.

Xylol.—MANCHESTER: 3s. 2d. to 3s. 6d. per gal.

General News

RAYON YARN PRICES are to be raised by a further 3½d. per lb. on March 1. The rise is said to be due to increased production costs.

THE OFFICES of the Trade Delegation of the U.S.S.R. in London have been removed from 51-53 Hatton Garden, E.C.1, to "Westfield," 32 Highgate West Hill, N.6.

THE MINISTRY OF AIRCRAFT PRODUCTION has published four specifications (D.T.D. 451-454) dealing with Synthetic Resin (Phenolic) Moulding Materials and Mouldings, classified according to their capability of shock resistance.

UNDER THE TERMS of the Export of Goods (Control) No. 3 Order, 1941, which came into force on January 23, a licence from the Board of Trade is required to export to any destination aluminium leaf and foil, whether or not backed with other material and certain forms of glass and glassware.

OVER A MILLION WORKERS in the engineering industry will benefit by an award issued by the National Arbitration Tribunal in London on Tuesday. The tribunal decided that the national bonus be increased by 2s. 6d. a week to all adult male workers from the start of the first full pay period following January 20.

SCIENTIFIC APPARATUS used by Dalton, the chemist and mathematician who propounded the atomic theory of chemical action, are among treasures believed to have been destroyed in a recent raid in Manchester. The apparatus was one of the show pieces at the home of the Literary and Philosophical Society, which was wrecked.

IN VIEW OF THE NEED for limiting the use of wood wool to essential purposes, it has been decided to introduce, from February 1, a system of control over the deliveries of wood wool by manufacturers and merchants. Inquiries regarding the system should be addressed to the Assistant Secretary, Industrial Supplies Department, Board of Trade, Millbank, London, S.W.1.

THE NATIONAL SURVEY undertaken by the Ministry of Supply (Iron and Steel Control) to record and classify all available fixed and demolition scrap iron has been extended to the Midland Counties. The whole of Scotland, London, Glamorgan and Somerset and all the northern counties of England have been surveyed, and encouraging reports are being received from every area.

UNDER AN ECONOMIC AGREEMENT just made between the British Government and General de Gaulle's Council of Defence, the British Government has agreed to purchase from the French Cameroons the total output of cocoa, palm kernels, palm oil, groundnuts, and beniseed (sesame), as well as a large proportion of local food products. In a similar agreement with the Belgian Congo the purchase by the British Government of 126,000 metric tons of copper, as well as palm kernels and palm oil, has been agreed upon.

Foreign News

THE PRODUCTION OF FELDSPAR in Canada in 1940 was about double that of 1939, figures for the first six months being 9075 and 4697 tons, respectively.

THE DENVER EQUIPMENT CO., of Denver, Colorado, have distributed copies of their large wall calendar for 1941. In these days of paper shortage this calendar is very welcome.

THE MANUFACTURE OF POTASSIUM CYANIDE for the first time in the United States is announced by E. I. du Pont de Nemours and Company. American raw materials will be used exclusively.

THE OFFICIAL GAZETTE of the German military command in occupied France is reported to contain a requisition decree for certain raw materials for chemical manufacture. Items included are sulphur, phosphate rock, iodine, opium, arsenic, sodium borate, boric acid, toluene, and agar-agar. Holders of stocks are forbidden to increase prices above the levels prevailing at the occupation of France by the German forces.

THE A.N.I.C. (Azienda Nazionale Idrogenazione Combustibili), of Milan, claims to be successfully producing iso-octane by alkylation of butylene with isobutane in the presence of 98 per cent. sulphuric acid at a temperature between 0° and 20° C. This method was preferred to the polymerisation of isobutylene with successive hydrogenation of di-isobutylene because of the lower cost of alkylation plants and the larger quantity of fuel obtained.

From Week to Week

THE LEGISLATIVE COUNCIL of the Federated Malay States imposed last Monday a war-tax of 2½ per cent. *ad valorem* on all rubber produced in and exported from the colony, states a Reuter report from Singapore. A war-tax on tin exports is also likely to be imposed, and it is expected that all Malaya will follow suit.

THE FIRST AVIATION PETROL of octane value 80-87 to be manufactured from the crude oil of Turner Valley, Alberta, is being produced this month by the British American Oil Co., Ltd., East Calgary, states *Canadian Chemistry and Process Industries*. Production of Alberta oil for 1940 is estimated at eight million barrels, 500,000 more than the 1939 yield.

GLYCERINE IS NOW BEING PRODUCED synthetically in the U.S.A. on a commercial scale from petroleum, the American Petroleum Institute reports. The synthesis of glycerine begins with the separation of propylene from petroleum refinery gases. The propylene reacts with chlorine to form allyl chloride, from which allyl alcohol is made, this being converted into glycerine.

IT IS ANNOUNCED that the importation into Canada of aluminium, manufactured or unmanufactured (including articles of which aluminium forms fifty per cent., by volume, of the component materials, or of which aluminium exceeds in value all other single component materials) is prohibited, except under a permit issued by, or on behalf of, the Minister of National Revenue.

SEAWEEDS GATHERED in the Far Eastern waters of the Soviet Union are exploited on a very large scale as raw materials for chemicals, apart from their utilisation for edible purposes. In Russian Pat. 51,091 is described a process for multi-stage electrolysis of a crushed suspension of seaweed resulting in successive isolation of iodine, bromine, mannitol, cellulose and alginates.

THE MARKED REDUCTION in the export of citrus fruits from Palestine, caused by war conditions, has led to a serious consideration of expanding the manufacture of by-products. By-product manufacturers will receive a refund of half the amount of a new tax which has been imposed to establish a minimum price for the fruit, states a correspondent in *The Times*, and projects are now on foot for the manufacture of 25,000 tons of citric acid annually.

ONE EFFECT OF THE BRITISH BLOCKADE, according to an American consular report published in the Mineral Trade Notes of the U.S. Dept. of the Interior, is that lithium is to be added to the list of raw materials produced by the Boliden Co. of Sweden. The mineral will be obtained from the lithium-pegmatite deposits at Varuträsk, which is between Boliden and the town of Skellefteå in northern Sweden. A plant for processing the material is to be built at Oskarshamn, where a leading Swedish manufacturer of storage batteries and dry cells already has a factory in operation. It is believed that the Varuträsk lithium will be sufficient to meet Swedish demands.

Forthcoming Events

THE NEXT MEETING of the Electrodepositors' Technical Society will take place on January 27 at the Northampton Polytechnic, St. John Street, Clerkenwell, E.C.1, at 3 p.m., when a paper on "The Anodic Polishing of Electroplated Nickel" will be presented by Messrs. A. W. Hotherhall and R. A. F. Hammond.

ON JANUARY 28 a special afternoon lecture for members of the Royal Institution of Great Britain and their friends will be delivered at the Royal Institution, 21 Albemarle Street, London, W.1, at 2.30 p.m., by Sir William Bragg, Fullerian Professor of Chemistry, whose subject will be "Diffraction."

AT THE MEETING of the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, on January 29, at 1.45 p.m., a paper on "Municipal Manufacture of Humus from Habitation Wastes" will be read by Lt.-Col. F. C. Temple, C.I.E., V.D., M.Inst.C.E., M.I.Mech.E. Dr. W. Allen Daley, Medical Officer of Health to the London County Council, will preside.

A JOINT MEETING of the Plastics Group, Society of Chemical Industry, with the Chemical Society will be held at Burlington House, Piccadilly, W.1, on February 6, at 1.45 p.m., when Mr. F. W. Clark, B.Sc., F.I.C., will read a paper on "Plasticisers."

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

LAFARGE ALUMINOUS CEMENT CO., LTD., Ripley, Surrey. (M., 25/1/41.) January 9, debenture to Lloyds Bank, Ltd., securing all moneys due or to become due to the Bank; general charge. *£4144. October 9, 1940.

LONDON FERRO-CONCRETE CO., LTD. (M., 25/1/41.) January 9, charge to National Provincial Bank, Ltd., securing all moneys due or to become due to the bank; charged on contracts. *£8000. September 16, 1940.

Satisfactions

C. O. MANSEL AND CO., LTD., Birmingham, metal manufacturers. (S., 25/1/41.) Satisfaction January 7, £1000, registered June 30, 1931.

CRONE AND TAYLOR, LTD., St. Helens, fertiliser manufacturers. (S., 25/1/41.) Satisfaction January 9, of debentures registered January 6, 1934, to the extent of £1000.

ALUMINIUM PROTECTION CO., LTD., London, N.W. (S., 25/1/41.) Satisfaction January 4, of debentures registered March 24, 1938, to the extent of £600.

Company News

British Emulsifiers, Ltd., report a total loss of £8,754 to September 30, 1940, less £1085 credit brought in, leaving £7669 debit forward. No dividend has been declared (last year 2 per cent.).

The Standard Chemical Co., Ltd., Canada, reports for the six months ended September 30, a net profit of \$41,941 after depreciation and taxes. (Corresponding period last year profit of \$4849 before depreciation and taxes.)

Redfern's Rubber Works, Ltd., Hyde, Cheshire, announce that final dividends for 1940 are recommended as follows: 3½ per cent. on A and B preference shares (making 7½ per cent. for the year); 6½ on ordinary shares (making 10 per cent. for the year), plus a bonus of 2 per cent. Net profits amount to £41,687 (last year £45,827). Meeting, February 15, at Hyde.

The directors of the **Midland Bank, Ltd.**, report that the net profits for the year ended December 31 amounted to £1,933,092 19s. 4d., which, with the balance of £642,217 9s. 8d. brought forward, makes a total of £2,575,310 9s. Out of this amount an interim dividend for the half-year ended June 30, 1940, at the rate of 8 per cent., less income tax at 7s. 6d. in the £, amounts for £757,931 1s.; £250,000 is allotted to reserve, and the same amount to war damage account; and a dividend, payable February 1, 1941, at the rate of 8 per cent., less income tax at 8s. 6d. in the £, making 16 per cent. for the year, amounts to £697,296 11s. 4d., leaving a balance of £620,082 16s. 8d. to be carried forward to next account.

New Companies Registered

Thames Chemicals, Ltd. (364,843).—Private company. Capital, £1000 in 1000 shares of £1 each. Manufacturers of and dealers in chemicals, acids, salts, gases, drugs, medicines, gypsum, plasters, disinfectants, fertilisers, oils, colours, scientific equipment, etc. Directors: Stephen Docwra and H. A. Mumford. Registered office, 34 Norfolk Street, W.C.2.

Melton Metallurgical Laboratories, Ltd. (364,883).—Private company. Capital, £1000 in 1000 shares of £1 each. Manufacturers of metallising solutions for dielectrics and other electrical purposes, manufacturers of low melting point solders and flux, research workers, etc. Directors: Cecil T. Walmsley, 9 Spring Vale, Crippenham, Bucks; Edward Ross; and Mrs. Margaret A. Holden.

John Townroe & Sons, Ltd. (364,877).—Private company. Capital, £1500 in 1500 shares of £1 each. Chromium, electro, nickel, and silver platers, gilding, oxidising, bronzing, lacquering, polishing, spraying, enamelling, metal plating or depositing on metals, timber, glass, porcelain, pottery or other materials, etc. Directors: Alfred P. Leonard and John A. Leonard. Registered office, 138 West Street, Sheffield, 1.

Bailey's Fertilisers, Ltd. (364,920).—Private company. Capital, £2000 in 1500 10 per cent. cumulative redeemable preference shares of £1 each and 500 ordinary shares of 2s. each. Manufacturers of and dealers in fertilisers, chemicals, sulphate of ammonia, superphosphates, ammonia, guano, sprays and fungicides, seed crushers, oil refiners, etc. Subscribers: P. M. Browne; E. F. Rudland. Registered office, 82 King William Street, E.C.1.

Frank Howard Engineering Company, Ltd. (364,871).—Private company. Capital, £100 in 500 shares of 4s. each. Manufacturers, engineers and designers in metal, wood, glass, synthetic compounds, etc., makers of paper and cardboard containers, paint makers and sprayers, etc. Permanent directors: Howard Harrison and Frank Howard Lane. Registered office, Pantiles, Wimscombe Way, Stanmore, Middlesex.

Chemical and Allied Stocks and Shares

FAILURE of business in the stock and share markets to show improvement was followed this week by a moderate reaction in industrial securities, which, however, were in many cases higher on balance. British Funds remained firm, and it is generally expected that proceeds arising from the requisitioning of further American dollar securities will be re-invested in a wide range of British stocks and shares.

Shares of chemical and kindred companies were relatively firm, and although best prices touched during the past few days were not held, they were mostly higher on balance for the week. Imperial Chemical were 30s. 9d., compared with 30s. 3d. a week ago, but following their strong upward movement, the 7 per cent. preference units eased from 34s. to 33s. 9d. Business in B. Laporte was recorded at the higher level of 55s. at one time, and Fison Packard and Prentice changed hands up to 31s. 10½d. Lawes Chemical transferred at 7s. 6d., while Greeff-Chemicals 5s. units were quoted around 6s., and British Drug Houses ordinary shares showed business at the higher price of 22s. 4½d. Monsanto Chemicals 5½ per cent. preference recently transferred at 22s. 7½d. British Glues participating preference, although "xd." again transferred at 28s., and the 4s. ordinary shares were quoted at 6s. 6d. A feature of interest has been further improvement in Borax Consolidated deferred units, which are 28s. 1½d. at the time of writing, as compared with 26s. 3d. a week ago.

Rather more attention has been given to smaller-priced securities, including General Refractories 10s. ordinary, which on the week have improved from 7s. 6d. to 8s. 4½d. British Plaster Board 5s. shares further improved from 13s. to 13s. 6d. Moreover, Imperial Smelting were 11s. 3d. compared with 10s. 6d. a week ago, while Low Temperature Carbonisation 2s. shares were firmer and were quoted at 1s. 3d. Morgan Crucible 5½ per cent. first preference showed business at 21s. 10½d.

Turner and Newall have risen on balance from 68s. 1½d. to 71s. 3d. There was also activity in Dunlop Rubber units, which further improved to 34s. 6d. on market hopes that the distribution for the year may be maintained at 12 per cent.; in some quarters a small increase is considered to be possible. Courtaulds were higher at 34s. 7½d.; in this case a better dividend is generally expected, but estimates of the payment do not exceed 10 per cent. On the basis of the latter, the yield would still be small, but this has to be read in relation to the exceptionally strong balance-sheet position. British Aluminium had a firmer appearance at 42s. 6d., and elsewhere, a further rise from 66s. 3d. to 67s. 6d. was shown in British Oxygen. Nairn and Greenwich held their recent rally to 50s. aided by the statements at the annual meeting, and Barry and Staines at 26s. 3d. were again higher, the price a week ago having been 21s. 6d. Distillers ordinary units reflected the general tendency, and were 68s. as compared with 66s. a week ago, while United Molasses were 9d. better at 24s. 9d. In other directions, Pinchin Johnson moved up from 19s. 6d. to 21s. 3d., and Wall Paper Manufacturers deferred units from 21s. 9d. to 23s. 1½d.

In the iron and steel section, prices were also higher on balance with Tube Investments 91s. 6d.; Stewarts and Lloyds, 43s. 6d.; and Staveley 43s. 9d. Associated Cement were higher at 61s. 3d., but in other directions, British Match ordinary shares remained at 30s. 3d. Among other securities, Boots Drug were firmer at 40s.; while Beechams Pills deferred were better at 8s. 6d. awaiting the interim dividend announcements of leading subsidiary companies. Oil shares were again higher on balance, and more attention was given to the preference shares of the Burmah Oil and Anglo-Italian companies, yields on which are on the large side.

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